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(54) NON-LOCKING SWITCH FOR FILTER MONITORING

NICHTVERRIEGELNDER SCHALTER ZUR FILTERÜBERWACHUNG

INTERRUPTEUR DE CONTROLE NON BLOQUANT POUR SURVEILLANCE DE FILTRE

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Description

Technical Field

[0001] Various embodiments of the present invention concern devices for monitoring fluid-filter performance, particularly devices that incorporate an electrical switch responsive to a differential pressure. Some embodiments of the invention may also be used in other applications.

Background

[0002] Many modern systems include air or liquid filters to ensure proper or reliable performance. For example, automobiles include air and fuel filters to remove dirt and other particulates from the air and fuel that are mixed and then ignited within their internal combustion engines. As a consequence of their proper operation, these filters collect particulates over time and increasingly restrict the flow of air or fuel into engines. Eventually, the filters become more restrictive than desirable and require replacement.

[0003] To facilitate timely filter replacement, automobiles and other systems sometimes include filter-monitoring devices, which monitor pressure or vacuum levels that result from fluid flow through associated filters. These devices are calibrated to detect when particular pressure or vacuum conditions occur and to respond to such occurrences in particular ways. For example, some devices, referred to herein as filter-monitoring switches, open or close an electrical switch, which is typically wired to illuminate a warning light or to send a signal to an engine computer for further processing.

[0004] FR2298097 discloses a filter monitoring switch having contacts for connection to an electric circuit, a conductive member for electrically coupling the contacts, a diaphragm coupled to move the conductive member, and a push plate coupled to the diaphragm and having a central pin coupled to the conductive member.

[0005] The present inventors have recognized that commercially available filter-monitoring switches suffer from at least three problems. First, some filter-monitoring switches are overly sensitive to spiking or fluttering pressures and thus prematurely signal filter replacement or provide a fluttering output signal that is difficult to process. Second, overly sensitive switches experience recurrent arcing between their electrical contacts that degrades performance, and often leads to premature failure of the switches. And, third, some switches allow dust and water intrusion that can also degrade performance and cause failures.

[0006] Accordingly, the present inventors have recognized a need to improve conventional filter-monitoring switches.

Summary

[0007] The present invention provides a filter monitoring switch as defined in the appended claims.

[0008] One exemplary filter-monitoring switch includes a diaphragm, and a switch defined by a conductor, and a pair of terminal contacts. In operation, the diaphragm flexes in response to differences in pressures on its opposing sides and causes the conductor to move relative to the pair of terminal contacts. Depending on initial position of the conductor and the differential pressure, movement of the conductor can make or break contact with the pair of terminals.

[0009] In one exemplary switch, the diaphragm separates a chamber into two parts, one coupled to the atmosphere and the other to a fluid inlet of an internal combustion engine. The fluid inlet receives filtered air or fuel from a corresponding filter. As the filter becomes dirty or clogged with particulates, it increasingly restricts fluid flow through the inlet and increases the differential pressure on the diaphragm, eventually forcing movement that either opens or closes the switch. The switch is coupled to an electric circuit, which operates an indicator lamp or sends an electrical signal to a vehicle computer system.

[0010] In some embodiments, the portion of the chamber coupled to atmosphere includes a vent hole, a dust cover, and a Teflon filter. The Teflon filter, which is sandwiched between a region surrounding the vent hole and the dust cover, not only safeguards the switch from water and dust intrusion, but also dampens response of the switch to pressure changes.

Brief Description of Drawings

[0011]

Figure 1 is a block diagram of an exemplary engine system 100 which corresponds to one or more embodiments of the invention.

Figure 2A is a cross-sectional view of an exemplary filter-monitoring switch 200, which corresponds to one or more embodiments of the invention.

Figure 2B is an exploded perspective view of filter-monitoring switch 200.

Figure 2C is a perspective view of an exemplary push plate which corresponds to one or more embodiments of the invention.

Figure 2D is a perspective view of an exemplary module 300 which corresponds to one or more embodiments of the invention.

Figure 2E is a perspective view of an exemplary terminal which corresponds to one or more embodiments of the invention.

Figure 3A is a cross-sectional view of an exemplary filter-monitoring switch 400, which corresponds to one or more embodiments of the invention.

Figure 3B is an exploded perspective view of switch 400.

Figure 3C is a perspective view of an exemplary dust cover which corresponds to one or more embodiments of the invention.

Figure 4 is a cross-sectional view of an exemplary filtering monitoring device 400, which corresponds to one or more embodiments of the invention.

Detailed Description of Exemplary Embodiment(s)

[0012] This description, which incorporates the above-identified figures and appended claims, describes one or more specific inventive embodiments. These embodiments, offered not to limit but only to exemplify and teach one or more inventions, are shown and described in sufficient detail to enable those skilled in the art to implement or practice the invention(s). The description may use terms, such as upper or lower in reference to specific features of various as embodiments; however, unless included in the claims, such terms are merely to aid correlating the drawings with the written description. Moreover, where appropriate to avoid obscuring the invention(s), the description may omit certain information known to those of skill in the art.

[0013] Figure 1 shows a block diagram of an exemplary engine system 100 which incorporates teachings of the present invention. System 100 includes an engine 110, a fuel filter 120, an air filter 130, filter-monitoring switches 140 and 150, and monitoring circuitry 160 and 170.

[0014] Engine 110 includes an air inlet 111 and a fuel inlet 112 for respectively channeling air and fuel into engine 110 for combustion according to known principles. In the exemplary embodiment, engine 110 takes the form of an internal combustion engine; however, in some embodiments, engine 110 takes other forms.

[0015] Fuel filter 120 provides a filtered fuel flow 121 through fuel inlet 112 to engine 110. In the exemplary embodiment, fuel filter 120 takes any convenient or desirable form.

[0016] Air filter 130, which is in fluid communication with air inlet 111, provides a filtered air flow 131 through inlet 111 to engine 110. In the exemplary embodiment, air filter 130 takes any convenient or desirable form.

[0017] Filter-monitoring switch 140, which is sized for operation as "air switch" or filter-monitoring air switch, includes a chamber 141, a calibration spring 142, a diaphragm assembly 143, and a terminal assembly 144.

[0018] Chamber 141 includes an inlet portion 141A, and respective upper and lower chambers 141B and 141C. Inlet portion 141 provides fluid communication between upper chamber 141B and air inlet 112. Upper chamber 141B, in the exemplary embodiment, snap fits onto lower chamber 141B. Lower chamber 141C includes a breather hole 141D which allows fluid communication between the lower chamber and ambient atmosphere. Hole 141D is covered with a dust cover 141E and a fluid filter 141F. Dust cover 141E sandwiches fluid filter 141F between an interior surface of the dust cover and a region surrounding hole 141D. In the exemplary em-

bodiment, fluid filter 141F consists essentially of a gas-permeable, water-repellant material, such as Porex IRM-0217 or XM-1484 (Teflon PTFE -- Polytetrafluoroethylene). However, some embodiments form the material using other vinyl polymers or other materials made from the monomer tetrafluoroethylene. Still other embodiments use felt or other porous filter media.

[0019] Calibration spring 142 fits between an upper interior surface of the chamber and diaphragm assembly 143, biasing response of the diaphragm assembly to differential pressures between the upper and lower chambers 141B and 141C. Some embodiments may omit calibration spring 142.

[0020] Diaphragm assembly 143 includes a deflectable diaphragm 143A, and a pin assembly 143B. Diaphragm portion 143A, which includes a flexible and substantially fluid impervious membrane, provides a generally fluid-tight seal between upper and lower chambers 141B and 141C. ('Generally fluid-tight,' as used herein, refers to a seal that has a leakage rate low enough to not interfere with the operation of the diaphragm and the filter-monitoring switch.) Diaphragm portion 143A deflects or otherwise moves from a neutral position N to another position F in response to a differential pressure between the upper and lower chamber portions, thereby moving pin assembly 143B up or down along a central axis 140A.

[0021] Pin assembly 143B includes a non-conductive pin portion 143C and a conductive portion 143D. Non-conductive pen portion 143C extends orthogonally away from the diaphragm portion 143A into lower chamber 141C. Conductive portion 143D, which has substantially the same width or outer diameter as that of pen portion 143C, making it flush with the surface of pin portion 143C. Conductive portion 143D is mounted at a position on pin portion 143C to ensure contact with terminals 144A and 144B of terminal assembly 144 when diaphragm portion 143A is in its neutral (or relaxed state.) The exemplary embodiment forms conductive portion 143D as a cylindrical bushing of hard gold plated brass that encircles pin portion 143C.

[0022] Terminal assembly 144 (or switch assembly) includes terminals 144A and 144B and a bias element 144C. Terminals 144A and 144B are spaced apart a distance Y, which is less than nominal width X of pin assembly 143B. Bias element 144C generally represents means for biasing terminals 144A and 144B to apply a substantially constant force to the pin assembly as it moves between the terminals in response to differential pressures between the upper and lower chambers. Terminals 144A and 144B are electrically coupled to circuitry 150 via a two-terminal connector 151.

[0023] Circuitry 150 includes, in addition to connector 151, a warning lamp 152, a battery 153, a warning lamp 154, and a two-terminal connector 155. Warning lamp 152 and filter-monitoring switch 140 are coupled in series across battery 153, enabling switch 140 to activate or deactivate the lamp as diaphragm assembly 143 responds to differential pressure between upper and lower

chambers 141B and 141C. (In some embodiments, the warning lamps are replaced with input port for a vehicle computing system, which includes a analog-to-digital converter.) Battery 153 is also coupled across the series connection of warning lamp 154 and connector 155, which itself is connected to filter-monitoring switch 160.

[0024] Filter-monitoring switch 160, which not only operates warning lamp 154 in a manner similar to filter-monitoring switch 140, but also has a similar structure arrangement, includes a chamber 161, a calibration spring 162, a diaphragm assembly 163, and a terminal assembly 164.. Switch 160, however, is sized and constructed to operate as a "fuel switch." Additionally, in this exemplary embodiment, switch 160 is shown in a pressure configuration, with spring 162 positioned in a lower chamber 161C, rather than upper chamber 161B to counteract relative higher fluid pressures in upper chamber 161B. In contrast, switch 140 is shown in a vacuum configuration, with spring 142 positioned in upper chamber 141B to counterbalance the relatively higher atmospheric pressures in lower chamber 141C.

[0025] Figures 2A and 2B respectively show cross-sectional and perspective exploded views of an exemplary filter-monitoring switch 200. Switch 200 includes a housing assembly 210, a diaphragm assembly 220, and a switch module 230.

[0026] Housing assembly 210, which includes a housing 212, a cap 214, a filtration system 216, and a collar 218. In the exemplary embodiment, all components of the housing assembly, except for filter 216B and collar 218 are molded from Clariant Nylon 6/6 (13% Glass Filled.). Filter 216B is formed of Teflon PTFE, and collar 218 is formed of aluminum, with edge rolled down after assembly of the switch.

[0027] More particularly, housing 212, which in the exemplary embodiment has a generally cup-like structure, includes a fluid inlet 212A and a sidewall 212B. The height of sidewall 212B is selected not only to permit movement of diaphragm assembly 220, but also to prevent it from traveling too far during over-pressure situations. Housing 212 is attached to cap 214, for example via a snap fit, to form a chamber 213, having upper and lower chambers 213A and 213B analogous to chambers 141B and 141C in switch 140.

[0028] Cap 214, which is generally horn-shaped in the exemplary embodiment, includes a breather hole 214A, a stem portion 214B, and a rib portion 214C. Breather hole 214A is in fluid communication with ambient atmosphere through filtration system 216.

[0029] Filtration system 216 includes a dust cover 216A and filter 216B, with the dust cover adjacent an exterior portion of cap 214 sandwiching filter 216B. Air can enter the dust cover, and consequently the lower chamber, through one or more openings distributed in the sidewall of the cover.

[0030] Collar 218 encircles the interface between housing 212 and cap 214 to add further integrity and aesthetic appeal to the switch. Collar 218 includes upper and

lower rolled edges 218A and 218B. Some embodiments omit collar 218.

[0031] Diaphragm assembly 220, which provides a generally fluid tight seal between upper and lower chambers 213A and 213B, includes a diaphragm 222, a retaining ring 224, and a push plate 226.

[0032] Diaphragm 222 includes an annular outer bead 222A and an inner annular bead 222B, which peripherally bound a convex annular portion 222C. Outer bead 222A is sandwiched between respective annular portion of the upper and lower chambers, more precisely housing 212 and cap 214. Inner annular bead 222B is sandwiched between retaining push plate 224 and retaining ring 226, which engage each other via a snap fit. The exemplary embodiment forms diaphragm 222 from silicon or other suitable material.

[0033] Retaining ring 224 includes an annular trough 224A which seats a lower portion of calibration spring 225. The spring can be selected to calibrate the diaphragm so as not to deflect until a threshold pressure, or pressure difference is reached within the inner cavity. (Notably, the design of the diaphragm assembly is flexible in allowing in some switches the calibration spring to be placed in the upper chamber between the housing and retaining ring, and in others to be placed in the lower chamber between the cap and the push plate.) Retaining ring 224 also secures and seals the diaphragm against an annular flange portion 226A of push plate 226.

[0034] Push plate 226, which is also shown in Figure 2C as being generally a bell-shaped structure molded from Vydne 22HSP Nylon, includes an annular wall portion 226B, a plate portion 226C, a pin portion 226D, and conductive bushing 226E. Annular wall portion 226B includes an upper ridge 226BA which together with annular flange portion facilitate the snap fit with retaining ring 226. Plate portion 226C is bounded by annular wall portion 226B, and positioned intermediate upper ridge portion 226BA and annular flange portion 226A. Analogous to pin portion 143B in Figure 1, pin portion 226D extends orthogonally from a central region of plate portion 226C, with the lower end of the pin portion encircled by conductive bushing 226E. In one embodiment, conductive bushing is positioned closer to the end of the pin to define the switch as a normally open switch, and in another it is positioned further from the end of the pin to define a normally closed contact. The majority of the length of pin portion 226D extends through a guide hole 236A of terminal module 230.

[0035] Terminal module 230, shown also in Figures 2D and 2E, and 2F, includes a terminal assembly 234 and upper and lower portions 236 and 238. Terminal assembly 234 includes a pair of substantially identical non-contacting terminals 234A and 234B. Shown best in Figure 2D, terminal 234B includes a terminal pin 234BA, a terminal pad 234BB, and a leaf contact 234BC. Terminal pin 234BA, which is sized to engage or mate with a female connector (not shown), is formed of half-hardened brass and tin plated. Substantially covering terminal pad

234BB, leaf contact 234BC is formed of beryllium-copper and includes a spring portion 234BD. Insert-molded around terminal assembly 234 are upper and lower module portions 236 and 238.

[0036] In the exemplary embodiment, module portion 236 and 238 are formed of Vydyn Nylon 6/6 22 HSP. Upper portion 236 includes guide hole 236A and module support 236B. Lower portion 238 has a sleeve portion 238A with a notch 238B, with the sleeve portion extending from the opposite side of the module support as upper portion 236. Notch 238B extends along the length of the sleeve portion and engages with rib 214C in the stem portion of cap 214 to ensure alignment of guide hole 236A with central axis 202A and pin 226D and to provide additional rigidity. The module support is sealed around the prongs (terminals) to prevent contaminants from entering into the lower chamber.

[0037] In the exemplary embodiment, the terminal-module-to-cap interface is not fluid tight; however, a suitable connector adapted to fit within the stem portion of cap 214 can seal this portion of the cap and restrict breathing of the lower chamber to filtration system 216. The module structure is also attached to the cap, and the module structure does not move with respect to the housing assembly.

[0038] Figures 3A, 3B, and 3C respectively show cross-sectional and perspective exploded views of an exemplary filter-monitoring switch 300, which is structurally and functionally similar to switch 200, with the exception that switch 300 is intended for use in smaller spaces and greater differential pressures than switch 200 and includes a different dust cover 316B and a different diaphragm assembly 320.

[0039] Filtration system 316 includes a dust cover 316A and a filter 316B, with the dust cover and an adjacent exterior portion of cap 314 sandwiching filter 316B. Figure 3C, an underside perspective view of dust cover 316A, reveals interleaved ribs 316BA and 316BB and openings 316BC. Interleaved ribs 316BA provide a maze-type barrier between openings 316BC and a cavity 316BD that receives an upper portion of filter 316B.

[0040] Diaphragm assembly 320, which provides a generally fluid tight seal between upper and lower chambers 213A and 213B, includes a diaphragm 322, a retaining ring 324, and a push plate 326.

[0041] Retaining ring 324, which is generally dome shaped, includes an annular flange 324A which seats a lower portion of the calibration spring and upper hole 324B. Retaining ring 324 also secures and seals the diaphragm against an annular flange portion 326A of push plate 326. Push plate 326 is also dome shaped and includes an annular wall portion 326B, a plate portion 326C, a pin portion 326D, and conductive bushing 326E. Annular wall portion 326B includes upper snaps 326BA and a lower flange 326BB which respectively engage upper hole 324A in a snap fit arrangement, thereby securely sandwiching an inner bead of diaphragm 322 between the lower flanges of the retainer ring and the push plate.

Pin portion 326D extends orthogonally from a central region of plate portion 326C, with the lower end of the pin portion encircled by conductive bushing 326E.

[0042] Figure 4 shows a cross-sectional view of an alternative push plate 400, which may be substituted for the push plates of switches 140, 200, and 300 to reconfigure those switches as variable pressure sensors. Push plate 400, which is shown engaged with terminal module 230, includes a pin portion 410 which extends orthogonally from a central region of plate portion 226C, with the pin covered by a U-shaped resistive structure 412 that leaves a portion of the insulative pin exposed. As the push plate structure is moved up and down relative to the leaf contacts, the resistive structure and the leaf contacts are in contact and the length of the resistive material that conducts a current changes in proportion to the displacement of the push plate, thereby providing a current or voltage that varies in a predictable or substantially linear fashion. The majority of the length of pin portion 410 extends through guide hole 238C of terminal module 230.

[0043] Other embodiments based on this variable-resistance principle distribute a plurality of spaced-apart conductive segments or portions along the pin. As the pin moves through its range of motion, different conductive portions can contact the leaf assemblies. The different conductive segments can be selected to have different resistances. Thus, as the pin travels through its range of motion, the different resistances modulate the electrical signal passed between the leaf assemblies, effectively encoding the electrical signal with a measure of the diaphragm displacement, which in turn can be appropriately translated into a differential pressure across the diaphragm.

[0044] The switch can be configured for use in a pressure, vacuum, or differential pressure mode. In addition, the switch can be configured to be normally open or closed, or in "closed but variable resistance mode," or the like. In one example, the operating range of switch where the filtered fluid is air is between 13 to 30 inches of water. In another example, the operating range of the switch where the filtered fluid is a liquid is typically between 3 to 13 inches of mercury. Other calibrations are possible.

Advantages of Various Embodiments

[0045] Various embodiments of the invention provide the following advantages. Some embodiments exhibit improved damping characteristics in response to pressure spikes and pulsing that can lead to premature signaling and fluctuating signals. Damping is achieved in part by using a large deflectable diaphragm and a large inner cavity volume. These two properties slow the response time and minimize or reduce the force-to-friction ratio in the switches. The large size and calibration spring prevent the switch from moving until the pressure gradient is close to the selected level. Various embodiments has also shown an ability to function properly in temper-

ature extremes (between -40 and 230 degrees F) and under vibration (between 20 to 200 Hz and 4g).

[0046] Some embodiments are less likely to experience intrusion of dust and water or other contaminants that could otherwise interfere with normal operation. The housing assembly in one or more of the embodiments includes three components---the housing, the cap, and the dust cover, which collectively or individually reduce the amount of liquid or debris intrusion. The tortuous or maze-like channels dissipate the energy of any stream of contaminants. Drain holes are included to vent or remove contaminants. The use of obstructions, tortuous channels absorb and disperse the energy of potentially intrusive fluid streams, and drainage holes allow contaminants to drain away. Additionally, the small water-repellant filter provides an additional barrier against contaminants.

[0047] Some embodiments are relatively insensitive to switch orientation as a result of the light weight of the moving switch components. Some embodiments have a relatively low and substantially constant switch-contact force, which results in reduced hysteresis. Moreover, the wiping action of the push-plate pin against the leaf contacts creates a self-cleaning, self-healing switch.

Conclusion

[0048] The foregoing description and examples have been given for clarity of understanding only. Those skilled in the art will recognize that many changes can be made in the described examples without departing from the scope of the invention defined by the claims.

Claims

1. A filter-monitoring switch (200,300) comprising:

first and second contacts for connection to an electric circuit;
a conductive member (226E, 326E) for electrically coupling the first contact to the second contact;
a diaphragm (222, 322) coupled to move the conductive member (226E, 326E); and
a push plate (226, 326, 400) coupled to the diaphragm (222,322) and having a central pin (226D, 326D) coupled to the conductive member (226E, 326E), **characterized in that** the conductive member (226E, 326E) is located along a length of the central pin (226D, 326D), and has substantially the same outer diameter as a non-conductive portion of the central pin (226D, 326D).

2. The switch of claim 1, further comprising a guide structure (236A) having a hole through which the central pin (226D, 326D) extends, the guide structure

(236A) being fixed relative to the first and second contacts to guide movement of the central pin (226D, 326D) along an axis (202) between the first and second contacts.

3. The switch of claim 1, wherein the conductive member (226E, 326E) is cylindrical and encircles a portion of the central pin (226D, 326D).

4. The switch of claim 1, further comprising first and second terminals (234A, 234B) that are electrically and mechanically coupled respectively to the first and second contacts; and a terminal support structure (236, 238) that is insert-molded around the first and second terminals (234A, 234B).

5. The switch of claim 2, wherein the terminal support structure (236, 238) includes a sleeve (238A) around the first and second terminals (234A, 234B), with the sleeve (238A) including a notch (238B) generally parallel to the first and second terminals (234A, 234B).

6. The switch of claim 1, wherein each of the first and second contacts includes a leaf contact (234BC) biased toward the conductive member (226E, 326E).

7. The switch of claim 1, further comprising a Teflon filter (141F) and a cover (141E).

8. The switch of claim 1, wherein the push plate (226, 326, 400) includes a cylindrical portion having a closed end and an open end, with the central pin (226D, 326D) extending from the closed end toward the open end, and the open end having an annular flange portion.

9. The switch of claim 1, further comprising a switch housing (212, 214) having first and second snap-together portions (212, 214), with the diaphragm (222, 322) having an annular outer portion and an annular inner portion, with the annular outer portion sandwiched between the first and second snap-together portions (212, 214) and an annular inner portion surrounding the cylindrical portion of the push plate (226, 326, 400).

10. The switch of claim 9, further comprising a retainer ring surrounding the cylindrical portion of the push plate (226, 326, 400) and retaining the annular inner portion of the diaphragm (222, 322) against the annular flange portion of the push plate (226, 326, 400).

11. The switch of claim 1:

wherein the first and second contacts are biased against the central pin (226D, 326D); and

wherein the central pin (226D, 326D) is non-conductive and has a nominal width and the conductive member (226E, 326E) has a nominal width that is substantially equal to the nominal width of the central pin (226D, 326D), thereby providing a switch-contact force between the contacts and the central pin (226D, 326D) that is substantially equal to a switch-contact force between the contacts and the conductive member (226E, 326E).

12. The switch of claim 1, further comprising means for self-cleaning the first and second contacts as the conductive member (226E, 326E) moves relative the first and second contacts.

13. The switch of claim 1:

wherein the first and second contacts are mounted within a separate terminal module (230) having terminals (234A, 234B) coupled to the contacts; and

wherein the switch further comprises a housing having an upper portion (212) for coupling to a fluid inlet of an engine and a lower portion (214) which snaps together with the upper portion (212) to secure the diaphragm (222, 322), the lower portion (214) defining a socket surrounding the terminal module (230).

14. The switch of claim 1, wherein the switch is non-locking.

Patentansprüche

1. Filterüberwachender Schalter (200,300), umfassend:

erste und zweite Kontaktelemente zum Verbinden mit einem elektrischen Kreislauf; ein Leitelement (226E, 326E) zum elektrischen Koppeln des ersten Kontaktelements mit dem zweiten Kontaktelement; eine Membran (222, 322), die zum Bewegen des Leitelements (226E, 326E) gekoppelt ist; und eine Pressplatte (226, 326, 400), die mit der Membran (222,322) gekoppelt ist und einen mittigen Stift (226D, 326D) aufweist, der mit dem Leitelement (226E, 326E) gekoppelt ist, **dadurch gekennzeichnet, dass** das Leitelement (226E, 326E) entlang einer Länge des mittigen Stifts (226D, 326D) angeordnet ist und im Wesentlichen den gleichen Außendurchmesser als ein nicht-leitender Teil des mittigen Stifts (226D, 326D) aufweist.

2. Schalter nach Anspruch 1, weiter umfassend eine

Führungsstruktur (236A) mit einem Loch, durch welches sich der mittige Stift (226D, 326D) erstreckt, wobei die Führungsstruktur (236A) im Verhältnis zum ersten und zweiten Kontaktelement befestigt ist, um die Bewegung des mittigen Stifts (226D, 326D) entlang einer Achse (202) zwischen dem ersten und dem zweiten Kontaktelement zu führen.

3. Schalter nach Anspruch 1, wobei das Leitelement (226E, 326E) zylindrisch ist und einen Teil des mittigen Stifts (226D, 326D) einkreist.

4. Schalter nach Anspruch 1, weiter umfassend einen ersten und zweiten Endpunkt (234A, 234B), die mit dem ersten bzw. dem zweiten Kontaktelement elektrisch oder mechanisch gekoppelt sind; und eine Endunterstützungsstruktur (236, 238), die um den ersten und zweiten Endpunkt (234A, 234B) herum umspritzt ist.

5. Schalter nach Anspruch 2, wobei die Endunterstützungsstruktur (236, 238) eine Hülse (238A) um den ersten und zweiten Endpunkt (234A, 234B) herum umfasst, wobei die Hülse (238A) einen zum ersten und zweiten Endpunkt (234A, 234B) generell parallelen Einschnitt (238B) aufweist.

6. Schalter nach Anspruch 1, wobei jeweils das erste und zweite Kontaktelement einen gegen das Leitelement (226E, 326E) vorgespannten Blattkontakt (234BC) umfasst.

7. Schalter nach Anspruch 1, weiter umfassend einen Teflonfilter (141 F) und eine Überdeckung (141 E).

8. Schalter nach Anspruch 1, wobei die Pressplatte (226, 326, 400) einen zylindrischen Teil mit einem geschlossenen Ende und einem offenen Ende umfasst, wobei sich der mittige Stift (226D, 326D) vom geschlossenen Ende gegen das offene Ende erstreckt, und das offene Ende einen ringförmigen Flanschteil aufweist.

9. Schalter nach Anspruch 1, weiter umfassend ein Schaltergehäuse (212, 214) mit einem ersten und zweiten Einrastteil (212, 214), wobei die Membran (222, 322) einen ringförmigen äußeren Teil und einen ringförmigen inneren Teil aufweist, wobei der ringförmige äußere Teil zwischen dem ersten und zweiten Einrastteil (212, 214) eingeschlossen ist, und ein ringförmiger innerer Teil den zylindrischen Teil der Pressplatte (226, 326, 400) umgibt.

10. Schalter nach Anspruch 9, weiter umfassend einen Haltering, der den zylindrischen Teil der Pressplatte (226, 326, 400) umgibt und den ringförmigen inneren Teil der Membran (222, 322) gegen den ringförmigen Flanschteil der Pressplatte (226, 326, 400) festhält.

11. Schalter nach Anspruch 1:

wobei das erste und zweite Kontaktelement gegen den mittigen Stift (226D, 326D) vorgespannt sind; und

wobei der mittige Stift (226D, 326D) nicht leitend ist und eine nominelle Breite aufweist, und das Leitelement (226E, 326E) eine nominelle Breite aufweist, die im Wesentlichen der nominellen Breite des mittigen Stifts (226D, 326D) gleich ist, wodurch eine Schalterkontaktkraft zwischen den Kontaktelementen und dem mittigen Stift (226D, 326D) bereitgestellt wird, welche im Wesentlichen einer Schalterkontaktkraft zwischen den Kontaktelementen und dem Leitelement (226E, 326E) gleich ist.

12. Schalter nach Anspruch 1, weiter umfassend Mittel zur Selbstreinigung des ersten und zweiten Kontaktelements, wenn sich das Leitelement (226E, 326E) im Verhältnis zum ersten und zweiten Kontaktelement bewegt.

13. Schalter nach Anspruch 1:

wobei das erste und zweite Kontaktelement innerhalb eines getrennten Endpunktmoduls (230) mit an den Kontaktelementen gekoppelten Endpunkten (234A, 234B) montiert sind; und wobei der Schalter weiter ein Gehäuse umfasst, welches einen oberen Teil (212) zum Koppeln mit einem Fluideinlass eines Motors und einen unteren Teil (214), der mit dem oberen Teil (212) in Eingriff geht, um die Membran (222, 322) zu befestigen, aufweist, wobei der untere Teil (214) einen das Endpunktmodul (230) umgebenden Sockel definiert.

14. Schalter nach Anspruch 1, wobei der Schalter nicht-verriegelnd ist.

Revendications

1. Interrupteur de surveillance de filtre (200,300) comprenant:

des premier et deuxième contacts pour la connexion à un circuit électrique;
un élément conducteur (226E, 326E) pour coupler électriquement le premier contact au deuxième contact;
un diaphragme (222, 322) couplé de manière à déplacer l'élément conducteur (226E, 326E); et
une plaque de poussée (226, 326, 400) couplée au diaphragme (222,322) et ayant une broche centrale (226D, 326D) couplée à l'élément conducteur (226E, 326E), **caractérisé en ce que**

l'élément conducteur (226E, 326E) est disposé le long d'une longueur de la broche centrale (226D, 326D), et présente essentiellement le même diamètre extérieur qu'une partie non conductrice de la broche centrale (226I, 326D).

2. Interrupteur selon la revendication 1, comprenant en outre une structure de guidage (236A) ayant un trou à travers lequel la broche centrale (226D, 326D) s'étend, la structure de guidage (236A) étant fixée aux premier et deuxième contacts de manière à guider le déplacement de la broche centrale (226D, 326D) le long d'un axe (202) entre les premier et deuxième contacts.

3. Interrupteur selon la revendication 1, dans lequel l'élément conducteur (226E, 326E) est cylindrique et entoure une partie de la broche centrale (226D, 326D).

4. Interrupteur selon la revendication 1, comprenant en outre des première et deuxième bornes (234A, 234B) couplées électriquement et mécaniquement respectivement aux premier et deuxième contacts; et une structure de support de bornes (236, 238) qui est moulée par insertion autour des première et deuxième bornes (234A, 234B).

5. Interrupteur selon la revendication 2, dans lequel la structure de support de borne (236, 238) comprend un manchon (238A) autour des première et deuxième bornes (234A, 234B), ledit manchon (238A) comprenant une encoche (238B) généralement parallèle aux première et deuxième bornes (234A, 234B).

6. Interrupteur selon la revendication 1, dans lequel chacun des premier et deuxième contacts comprend un contact à lame (234BC) sollicité vers l'élément conducteur (226E, 326E).

7. Interrupteur selon la revendication 1, comprenant en outre un filtre de Téflon (141F) et un couvercle (141E).

8. Interrupteur selon la revendication 1, dans lequel la plaque de poussée (226, 326, 400) comprend une partie cylindrique ayant une extrémité fermée et une extrémité ouverte, ladite broche centrale (226D, 326D) s'étendant à partir de l'extrémité ouverte vers l'extrémité fermée, et ladite extrémité ouverte présentant une portion de bride ouverte.

9. Interrupteur selon la revendication 1, comprenant en outre un boîtier d'interrupteur (212, 214) présentant des première et deuxième parties à encliquetage (212, 214), ledit diaphragme (222, 322) présentant une partie extérieure annulaire et une partie intérieure

re annulaire, ladite partie extérieure annulaire étant prise en sandwich entre les première et deuxième parties à encliquetage (212, 214) et une partie intérieure annulaire entourant la partie cylindrique de la plaque de poussée (226, 326, 400).

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10. Interrupteur selon la revendication 9, comprenant en outre un anneau de maintien entourant la partie cylindrique de la plaque de poussée (226, 326, 400) et maintenant la partie intérieure annulaire du diaphragme (222, 322) contre la partie de bride annulaire de la plaque de poussée (226, 326, 400).

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11. Interrupteur selon la revendication 1:

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dans lequel les premier et deuxième contacts sont sollicités contre la broche centrale (226D, 326D); et

dans lequel la broche centrale (226D, 326D) est non-conductrice et présente une largeur nominale et l'élément conducteur (226E, 326E) présente une largeur nominale qui est essentiellement égale à la largeur nominale de la broche centrale (226D, 326D), fournissant ainsi une force d'interrupteur et de contact entre les contacts et la broche centrale (226D, 326D) qui est essentiellement égale à la force d'interrupteur et de contact entre les contacts et l'élément conducteur (226E, 326E).

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12. Interrupteur selon la revendication 1, comprenant en outre des moyens d'auto-nettoyage des premier et deuxième contacts lorsque l'élément conducteur (226E, 326E) se déplace par rapport aux premier et deuxième contacts.

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13. Interrupteur selon la revendication 1:

dans lequel les premier et deuxième contacts sont montés dans un module séparé de bornes (230) présentant des bornes (234A, 234B) couplées aux contacts; et

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dans lequel l'interrupteur comprend en outre un boîtier ayant une partie supérieure (212) pour l'accouplement à une admission de fluide d'un moteur et une partie inférieure (214) qui s'enclenche avec la partie supérieure (212) de manière à fixer le diaphragme (222, 322), la partie inférieure (214) définissant une prise entourant le module de bornes (230).

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14. Interrupteur selon la revendication 1, dans lequel l'interrupteur est non bloquant.

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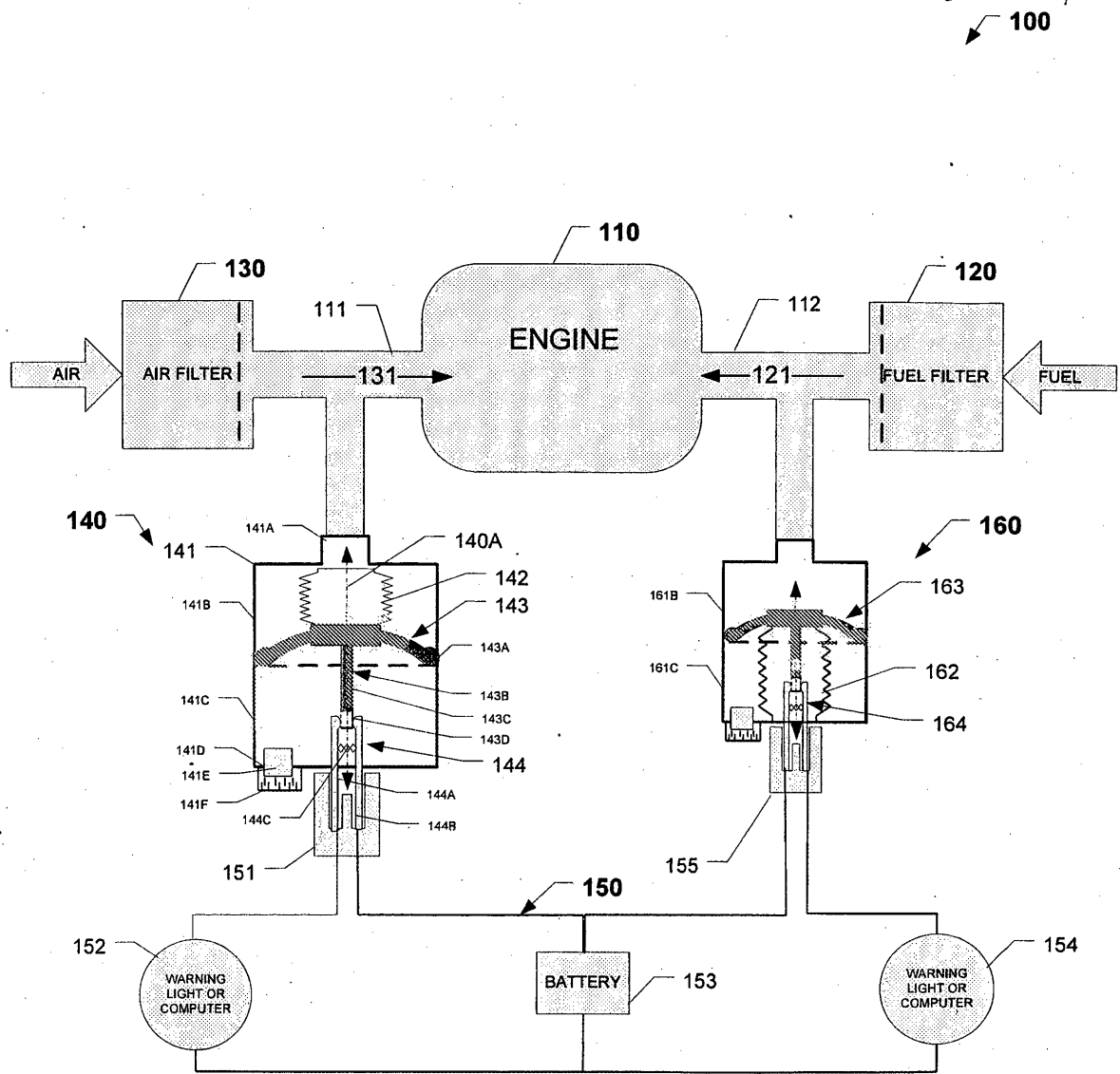


FIGURE 1

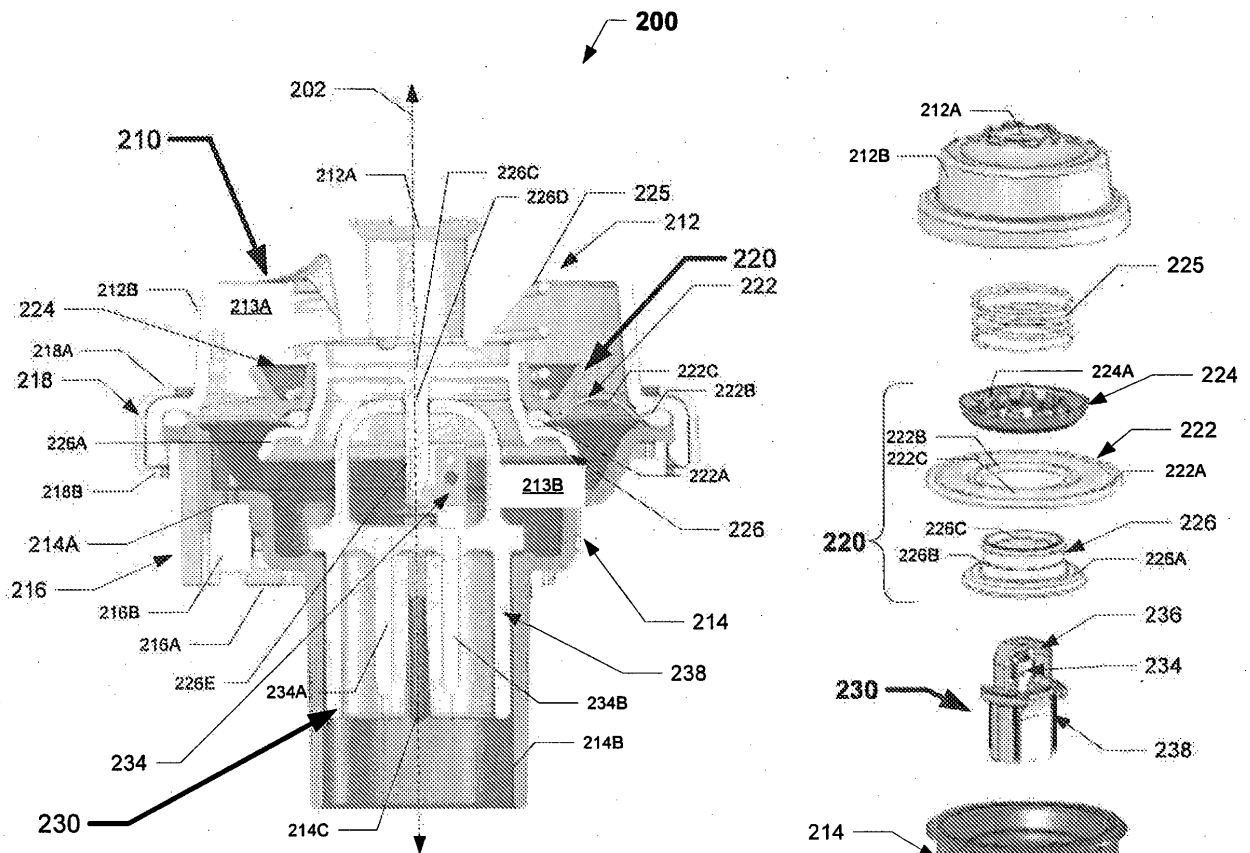


FIGURE 2A

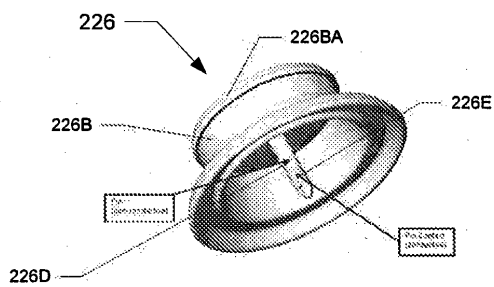


FIGURE 2C

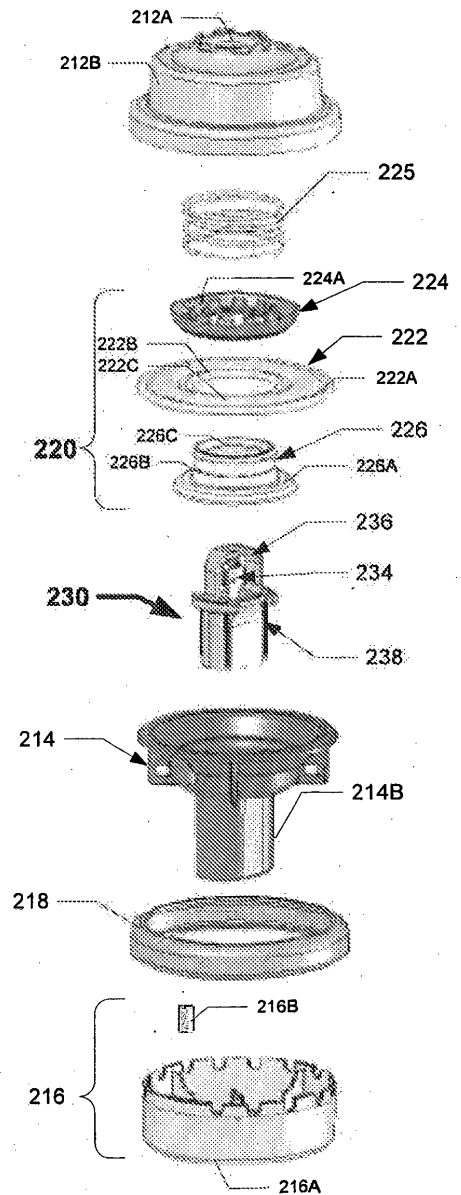


FIGURE 2B

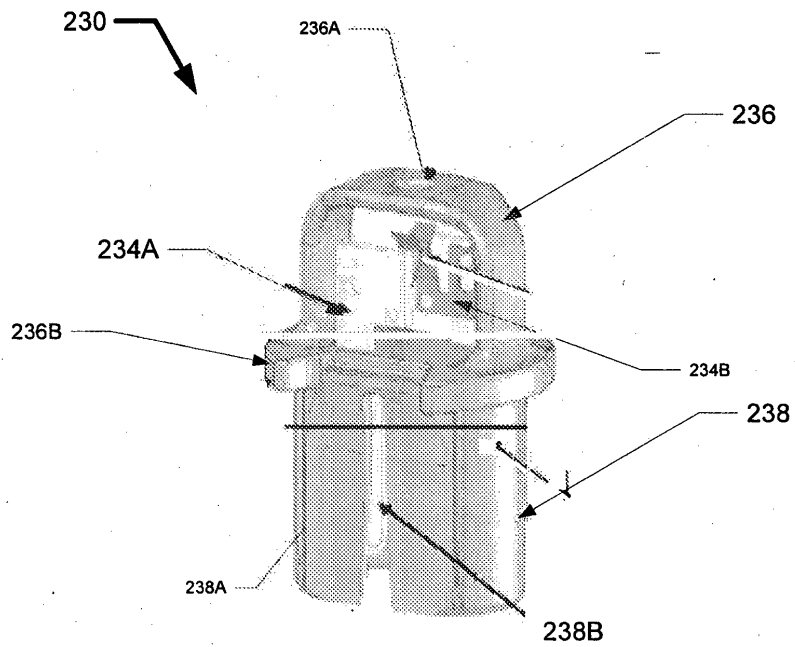


FIGURE 2D

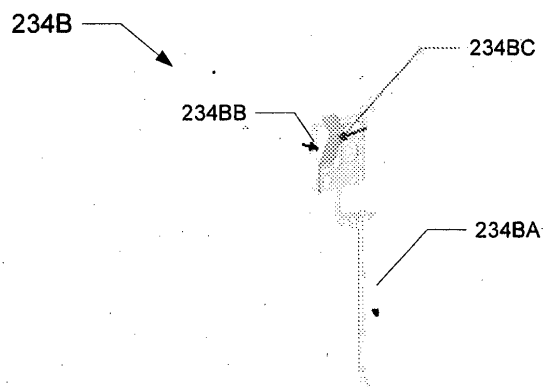


FIGURE 2E

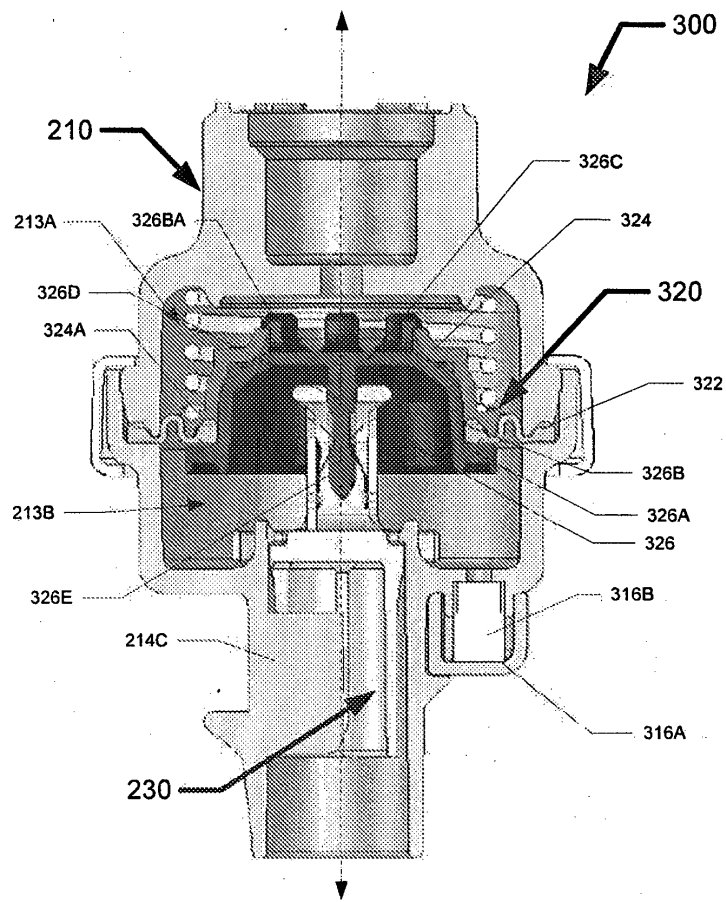


FIGURE 3A

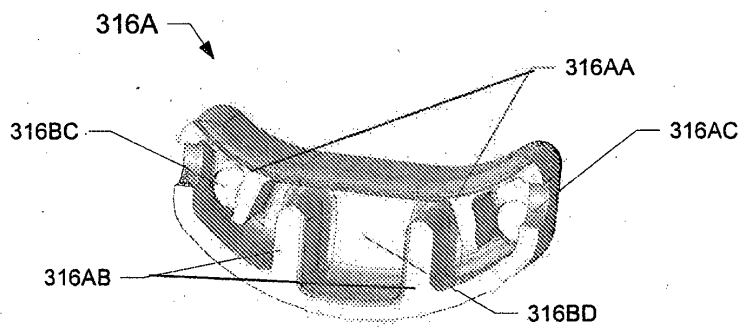


FIGURE 3C

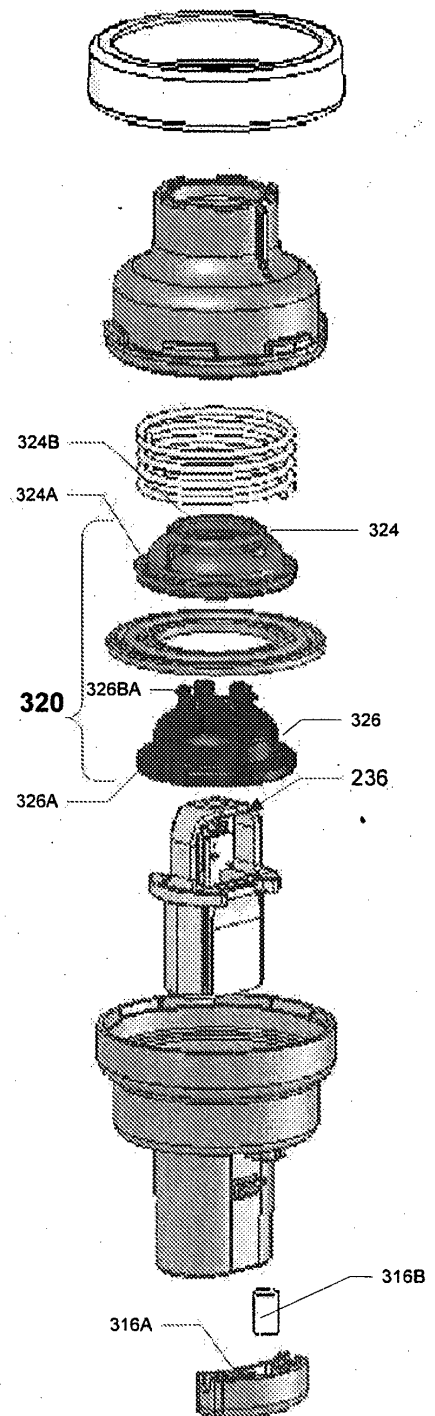


FIGURE 3B

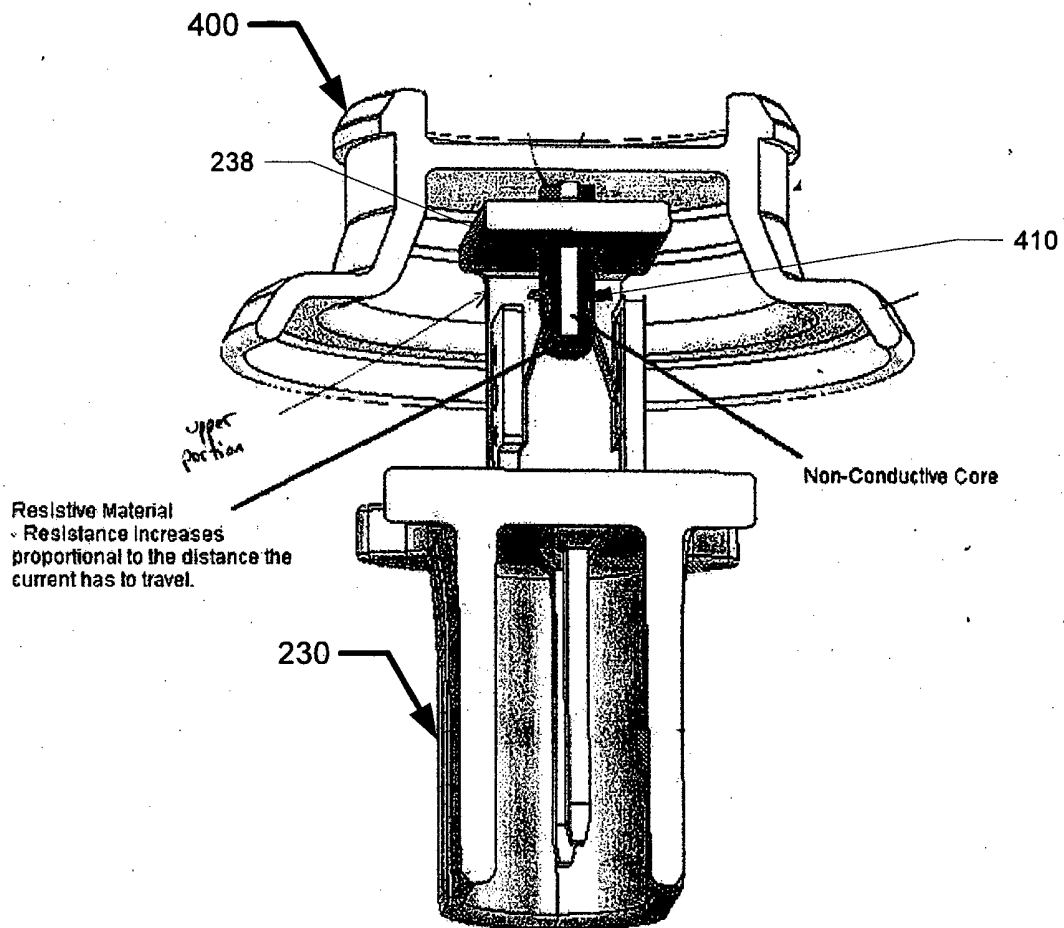


FIGURE 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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